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Overview of the Tuning Template for Radiography in Europe

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Preface

The following is an overview of the Tuning Template for Radiography Education in Europe developed by subgroup 1 of the HENRE II Thematic Network.

In this context, a template provides a description of a subject area (in this case radiography) as a guide for subject specialists to develop their own programme of study and for others to identify the scope of the subject area.

Tuning Educational Structures in Europe (Tuning), an EU funded Socrates Life Long Learning project, developed a methodology to design and to deliver degree programmes using a learning outcomes and competence framework approach linked to ECTS credits based on student workload.

The Tuning methodology consists of 5 lines:

Line 1. Generic Competences
Line 2 Subject Specific competences
Line 3 The role of ECTS as a credit transfer and accumulation system
Line 4 Approaches to learning, teaching and assessment
Line 5 The role of quality enhancement in the educational process

The Tuning Template for radiography, which deals with the Lines 1 to 4 inclusive, therefore provides particular reference points which allow for flexibility and autonomy in curriculum design and construction providing a common language and thus understanding to permit points of convergence in radiography programme

development. Programmes of study therefore should become comparable, compatible and transparent. Across Europe.

The Higher Education Network for Radiography in Europe (HENRE) has been instrumental in developing this template for the development of radiography degree courses thus making considerable strides in relation to the Bologna process.

The Bologna process aims to create a European Higher Education Area (EHEA) by 2010 making academic degree standards and quality assurance standards more comparable and compatible throughout Europe to enable students choice from a wide range of quality courses. It is named after the University of Bologna, when in 1999, the Bologna declaration was signed by Ministers of Education from 29 European countries.

The three priorities for Bologna are the recognition of a three cycle degree system (bachelor, masters, doctorate), quality assurance and qualification recognition.
Since Bologna, further Ministerial meetings have been held in Prague (2001), Berlin (2003), Bergen (2005) and London (2007) with a further meeting to be held in Leuven/Louvain-La-Neuve in April 2009.
For more information on Bologna, visit the following website:

http://ec.europa.eu/education/policies/educ/bologna/bologna_en.html

1. Introduction to radiography

Within the context of the Tuning template the reader should consider the term “Radiographer” to refer to the role of both diagnostic and therapeutic radiographers and the scope of practice to relate to Diagnostic Radiography, Radionuclide Imaging and Radiotherapy.

It is expected that the radiographer will have professional autonomy and accountability, develop good professional relationships, develop personal and professional skills and demonstrate an ethical and knowledgeable understanding of the profession. It is also expected that the application of radiographic and radiotherapeutic practice in securing, maintaining or improving health and well-being; the development of knowledge, understanding and skills that underpin their education and training will contribute to future health and wellbeing of the patient. It is considered vital that professional advancement arises out of evidence-based practice and is informed through focused research.

Radiographers are able to plan, organize, apply and evaluate their work process with the aims of promoting health, preventing disease, making the diagnosis and/or treating diseases. The radiographer is a healthcare team member who interacts with other professionals in the healthcare environment to provide an optimum diagnostic or therapeutic outcome.

The radiographer has the responsibility to:
Plan, prepare and perform safe and accurate imaging examinations, using a wide range of sophisticated equipment and techniques in the diagnostic field;

Plan, prepare and perform safe and accurate high-energy radiation treatments, using a wide range of sophisticated equipment and techniques in the therapeutic field.
While performing their role the radiographer is responsible for the radiation protection, patient care and quality assurance of the imaging or radiotherapeutic process.
Throughout Europe, in most countries, the national professional regulations govern the profession of radiography and within some countries professional/governmental registration is a requirement for practice. This system protects the interests of the service user. The radiography profession is typically governed by national Ministries responsible for Education and for Health. Furthermore, the radiography profession is regulated by the Directive 2005/36/EC of the European Parliament and of the Council on the recognition of professional qualifications; member states retaining the right to lay down the minimum level of qualification required to ensure the quality of the services provided on their territory.

2. Radiography Degree profile(s)

- First cycle education at bachelor level is the desired qualification for a first post radiographer.

- Second cycle education at a Master's level is the required qualification in a specific subject area in radiography and is intended for those who successfully completed first cycle studies.

- Third cycle education at a Doctoral level is the qualification aimed towards those who wish to research in the radiography field and is intended for those who successfully completed second cycle studies in the healthcare field. Radiographers can also follow doctoral programmes in other disciplines.

Degree profiles in radiography vary throughout Europe, in terms of the requirements for first post competencies related to specified imaging and therapeutic modalities. This has arisen from the different national traditions from which the profession developed, from the requirements of the service and from the variety of educational programmes which exist across Europe.

The Bologna process for Higher Education has provided the means to spearhead the development of radiography programmes which aim to ‘tune’ with each other eventually, in the long term, supporting the free flow of labour across the whole of Europe.

3. Introduction to TUNING

TUNING MOTTO: *Tuning of educational structures and programmes on the basis of diversity and autonomy*

Tuning is a 3 phase project supported by the EC as part of the Socrates Life Long Learning Programme and is university driven.

"*The term Tuning was deliberately chosen to reflect the idea that universities do not look for uniformity in their degree programmes or any sort of unified, prescriptive or definitive European curricula but simply points of reference, convergence and common understanding***"** Tuning Education Structures 2007

The points of reference referred to above by the TUNING project, are expressed as learning outcomes and competences. According to Tuning, learning outcomes and competences distinguish between the different roles of the academic staff and the students.

Degree programmes should specify the Intended Learning Outcomes (ILOs) at both programme level and at module/unit level and these are developed by academic staff in consultation with appropriate stakeholders e.g. professional bodies, employers etc.

Competences should be developed or achieved by the students during the learning process within the degree programme.

- A learning outcome is a statement of what a learner is expected to know, understand and/or be able to demonstrate at the end of a period of learning.

- Competence is a dynamic concept that integrates knowledge, skills, abilities, values and attitudes, the development and thus application of which enables the learner to perform effectively, to be able to recognize and respond to change and to treat service users appropriately.

The three cycle system (bachelor,masters, doctoral) has, according to Tuning, implied a move from a teacher led approach to a student centred approach.

The Tuning methodology has encouraged a European wide consultation process including students, academics and clinicians (representing employers) to identify the competencies that should be developed in a radiography degree programme. HENRE has undertaken a series of surveys in this respect, the latest being in May 2008.
http://tuning.unideusto.org/tuningeu/index.php?option=com_frontpage&Itemid=1

4. HENRE and Tuning

HENRE was originally appointed a Tuning councilor, Dr Heikki Pekarinnen of Finland in 2004 to explain and assist with embracing and implementing the Tuning methodology into the framework of the network.

HENRE has undertaken a considerable amount of work in relationship to the TUNING methodology through the use of various questionnaires undertaken by the HENRE sub groups.

4.1 Consultation process with stakeholders

When the Tuning project started there were few common platforms to address the Directives and stakeholders' involvement. Engaging with the Tuning process for radiography, initially involved a steering group from HENRE.

HENRE therefore consulted with a number of different agencies and professional groups. Within its membership are academics from Higher Education Institutions and other educational institutions offering radiography educational programmes, radiography practitioners, national radiography societies from across Europe, representing employers and practitioners and others.

Academics involved in the educational process of radiographers include, in addition to qualified radiographers, physicists, radiologists and others. Others stakeholders with interests in radiography and radiation protection include dentists and nurses.

Students were also consulted in relation to both generic and subject specific competencies.

Radiography practitioners, in a number of European countries have since had the opportunity to feed back and comment on the generic and specific competencies through a web-based questionnaire in May 2008.

The HENRE website is a useful source of information; see www.henre.co.uk . Look under HENRE phase 2 (2005-2008) TUNING section . Here you will be able to access some results from the work undertaken by HENRE including information related to the structure of a range of 1st cycle radiography programmes, learning and teaching methods, assessment methods and curriculum content for physics, anatomy & physiology, imaging techniques and professional skills.

The questionnaires related to generic and subject specific skills for first cycle radiography degree programmes originally distributed, provided insufficient returns for inclusion in the Tuning Template, a more recent on line questionnaire which sought views from radiography stakeholders, included academics, students and radiography clinicians (representing employers) provided a healthy 795 returns.

5. Competencies

5.1 Generic Competences

Generic competences can be viewed as transferable skills and are considered to be particularly important in relationship to the future employability and citizenship within Europe and the wider world (Gonzalez & Wagenaar 2007; p.139)

TUNING distinguishes three types of generic competences:
Instrumental competences: cognitive abilities, methodological abilities, technological abilities and linguistic abilities
Interpersonal competences: individual abilities like social skills (social interaction and co-operation)
Systemic competences: abilities and skills concerning whole systems (combination of understanding, sensibility and knowledge; prior acquisition of instrumental and interpersonal competences required)

The generic competencies to be achieved at the first cycle level by a Bachelor in radiography include:
Instrumental competencies - the skills and capacity for analysis and synthesis, organization, general knowledge and understanding of radiography, knowledge of own and a second language related to :

- Reflection on practice
- Positive attitude to responsibility for own learning
- Evaluation
- Problem Solving
- Research Skills

Interpersonal competencies – the skills required for teamwork, communication, positive criticism and self-criticism, ethical approaches, integration within multidisciplinary teams, understanding diversity and multi-cultural issues, related to the:

- Professional autonomy and accountability of the radiographer

- Professional relationships of the radiographer
- Personal and professional skills of the radiographer
- Profession and employer context

Systemic competencies – the skills to apply theoretical knowledge in practice, to learn, adapt to new situations, generate new ideas, leadership, and autonomy related to:

- Quality
- Project design and management
- Creativity

A total of 30 generic competences had previously been defined by Tuning, the following 27 (Table 1) were selected by the HENRE Tuning sub group as appropriate to radiography.

The on line survey asked participants to

a. rate the **importance** of generic academic skills in a medical diagnostic imaging and radiotherapy course at 1st cycle (bachelor) level and

b. rate the **achievement** of these generic skills by the extent to which they were/are developed in the education centre in which they presently work (academics) OR they presently attend (students) OR have previously attended (clinicians)

Table 1. Generic Competences

1	Capacity for analysis and synthesis
2	Capacity for applying knowledge in practice
3	Capacity to reflect on experience in practice
4	Ability to plan and time manage one's own workload
5	Possess general knowledge in field of study
6	Possess a grounding of knowledge of the profession in practice
7	Ability to communicate orally and written in native language
8	Knowledge of a second language
9	Appropriate understanding of I.T. skills
10	Awareness of research and its use
11	Positive attitude to a responsibility for one's own learning
12	Information management skills (ability to retrieve and analyse information from different sources)

13	Critical and self critical capabilities
14	Capacity to adapt to new situations
15	Capacity to generate new ideas (creativity)
16	Ability to problem solve
17	Possess decision making skills
18	Command of interpersonal skills
19	Initiative and leadership skills
20	Team working skills
21	Ability to communicate with non-experts in the field
22	Be able to work in an international context
23	Respect the diversity of cultures and customs of other countries
24	Be able to work autonomously
25	Project design and management
26	Demonstrate an ethical commitment
27	Evaluation and maintenance of quality of work

The rating scale used was from 1-4 for each competence and for a. and b.

For a. Level of importance (1 = least important through to 4= most important)

For b. Development in the education centre (achievement) (1= hardly developed at all; 2= some development; 3= developed; 4= well developed)

The University of Duesto, Spain, one of the TUNING partners, completed the statistical analysis and the HENRE Tuning sub group 1 interpreted the results provided by the analysis.

The total number of questionnaires completed in relation to generic competences was 426 which included 95 academics, 130 clinicians and 201 students from 17 different European countries.

5.1.1 Importance of Generic Competences

The importance of generic competences for 1st cycle radiography degree programmes showed average scores higher than 2.4 for all three groups of participants (viz. students, academics and clinicians [representing employers]) with the majority scoring 3 or over. Out of the total of 27 generic competences, students scored 6 with an average above 3.5; clinicians scored 7 with an average above 3.5 and academics scored 11 with an average above 3.5.

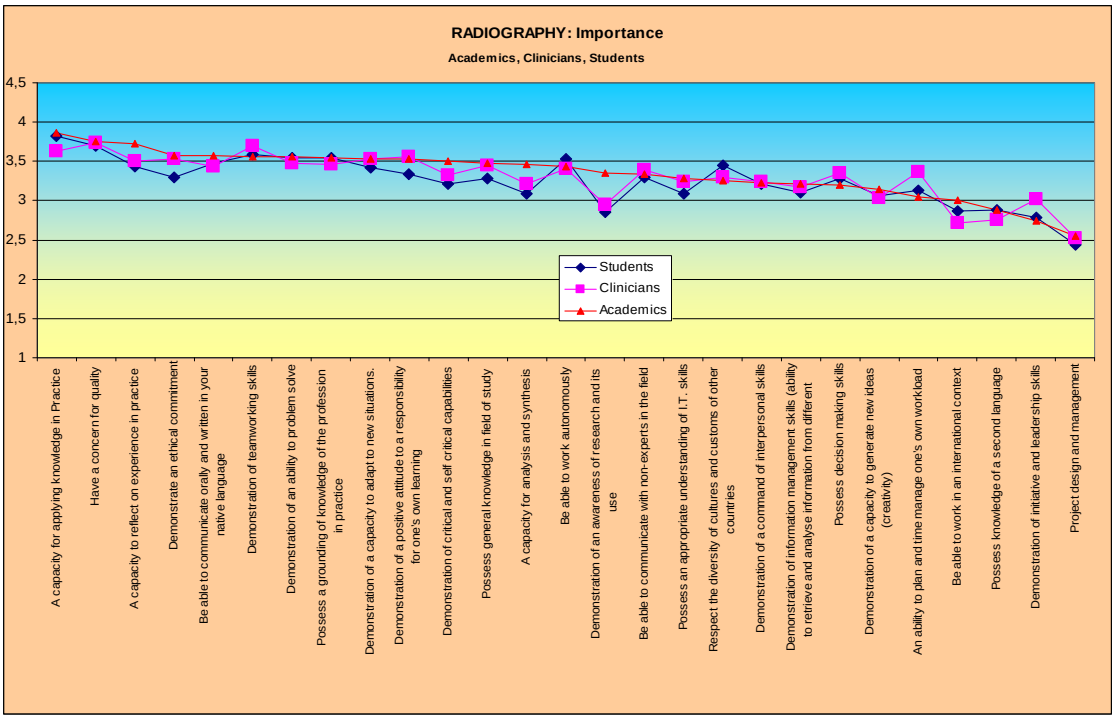
The following scored highest for students and academics i.e. a capacity for the application of knowledge in practice, a concern for quality and demonstration of team working skills. Academics scored highly on a capacity to reflect on experience in practice. See Table 2 below

Table 2 *Top ranking of generic competences (importance)- showing rank by each group*

Generic Competence	Students	Clinicians	Academics
A capacity for applying knowledge in practice	1	3	1
Ability to evaluate and maintain the quality of work produced	2	1	2
Demonstration of team working skills	3	2	6
The capacity to reflect on experience in practice	9	7	3
Possess a grounding in basic knowledge of the subject area	4	9	8

The generic competences deemed to be least important at 1st cycle to all 3 groups of participants were demonstration of initiative and leadership capacities; knowledge of a second language, working in an international context and involvement in project design and management. Students and clinicians scored on average below 3 for awareness of research whilst academics considered that research was considerably more important (ave score of 3.5).

Graph 1 *Radiography: 1st Cycle Generic Competences (Importance) Means according to respondent type (Academics, Clinicians, Students)*



From the above graph, it can be seen that there is close correlation of scores between the 3 types of respondents, apart from the one notable difference being between academics and the other types of respondents in relation to a demonstration of the awareness of research.

Also, it may be noted that students gave a lower score than clinicians and academics in relationship to the demonstration of an ethical commitment and clinicians gave a higher score than academics and students for demonstration of initiative and leadership skills.

5.1.2 Achievement of Generic Competences

In the context of the Tuning Template, the achievement of generic competences identifies the extent to which these were developed in radiography courses. Mean scores ranged from 2.15 to 3.35 across the 3 types of respondents with the highest score for all 3 types of respondents being the evaluation and maintenance of the quality of work. The application of knowledge in practice, use of information communication technology (ICT) and respect for diversity

and multiculturalism also scored highly; above an average score of 3 for all types of respondents.

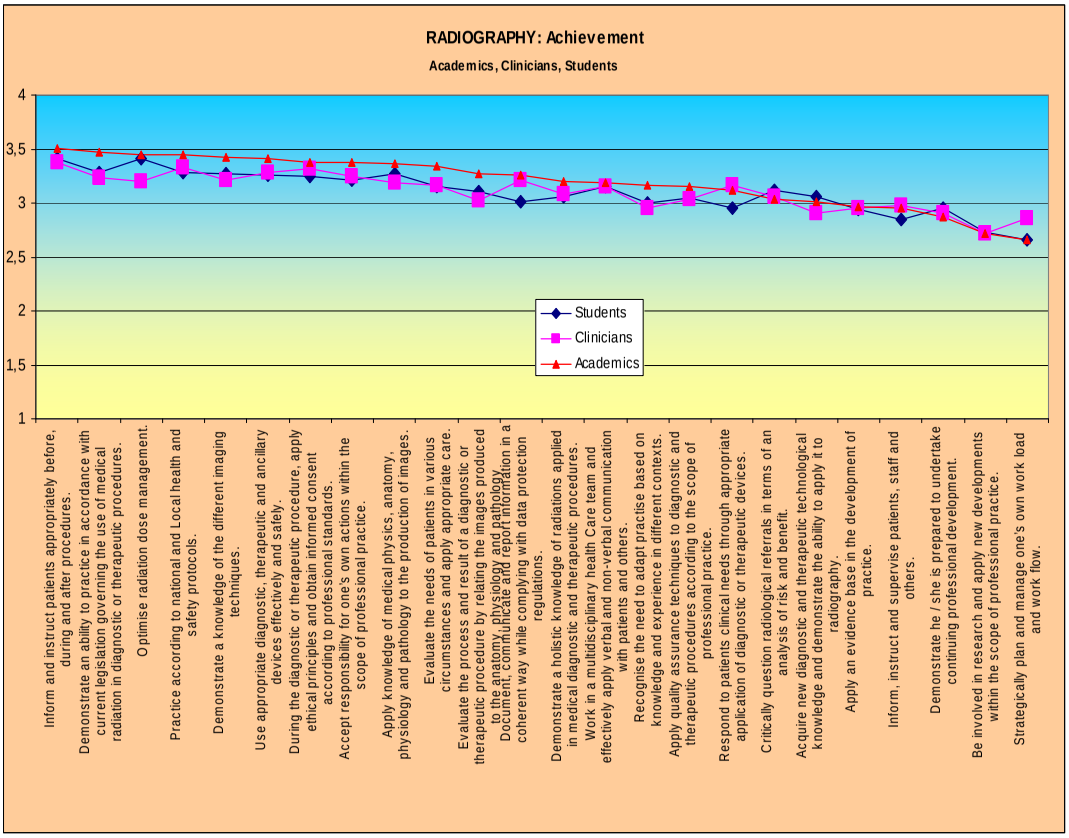
Table 3

Top ranking of generic competences (achievement)- showing rank by each group

Generic Competence	Students	Clinicians	Academics
Ability to evaluate and maintain the quality of work produced	1	1	1
A capacity for applying knowledge in practice	2	7	4
Appreciation and respect for diversity and multiculturalism	3	5	7
Skills in the use of information and communications technology	4	3	2
Ability to act on the basis of ethical reasoning	7	2	5
Ability to communicate both orally and through the written word	8	9	3

The lowest scores with an average score for all 3 types of respondents of 2.4 or lower were the ability to undertake research at an appropriate level, ability to communicate with non experts in one's field and possessing a capacity to generate ideas (creativity).

Graph 2 *Radiography: 1st Cycle Generic Competences (Achievement) Means according to respondent type (Academics, Clinicians, Students)*



As can be seen above, there is close correlation between all 3 types of respondents in relationship to a sense of achievement for most of the generic competences.

5.2 Subject Specific Competences

Subject specific competences are related to the performance of the radiographer and are competences that should be developed in any first, second and third cycle educational programme for radiographers.

The HENRE Tuning group (subgroup 1) adapted the list of competences from the "Academic and Practitioner Standards in Radiography" compiled in 2001 by the UK benchmark group for the award of a UK honours first cycle degree.

The subject specific competences identified are organised in sections describing:

- Skills/competences attributable to all radiographers
- Skills/competencies in diagnostic image production
- Skills/competencies in radiotherapy
- Skills/competencies in quality assurance
- Skills/competencies in radiation safety.

[It should also be noted that CPD and research skills are pertinent to each of the areas designated below].

First cycle subject specific skills/competencies

Competencies attributable to all radiographers

- care for and advise patients, family and carers, colleagues in diagnostic radiography and radiation therapy
- develop ethically sustainable decision making, health promotion and patient care attitudes, participating also in the continuity of patient care
- identify individual patient requirements for the planning, carrying out and evaluation of care delivered, based on optimal principles of patient care
- deal with ethical dilemmas arising in the workplace
- assess and administer essential medication used in the professional context
- show operational understanding of procedures for emergency first aid
- show knowledge of hospital acquired and other infections and the use of appropriate aseptic techniques
- show intercultural awareness and sensitivity in the workplace
- ensure confidentiality in the processing/handling of patient data
- be prepared to mentor students and new employees

Competences in diagnostic imaging

- use appropriate protocols and devices to carry out the optimal imaging examinations for specific medical conditions dependent on an overall assessment of the patient's condition
- use professional decision making, independently or as a team member in medical imaging procedures
- apply comprehensive understanding of imaging physics and human anatomy, physiology and pathology in the optimal production of high quality images
- understand the administrative and decision-making structures in departments of radiology
- assess and administer medicines, contrast media and radio pharmaceuticals to ensure the safe use of these in diagnostic imaging

- have a reflective attitude regarding the relationship between technology and human beings regarding risk analysis, eg in areas like the advisability to the individual of radiological examinations

Competences in radiation therapy

- optimise clinical practice protocols used in planning, simulation and administration of radiation therapies
- use professional decision making, independently or as a team member in planning and carrying out radiation therapy
- develop understanding of the administrative procedures used within radiation therapy and understand their meaning for total patient care
- be cognisant with administrative procedures used within radiation therapy and understand their implications for overall patient care

Competences in quality assurance in radiography and radiation therapy

- understand the key concepts related to quality development, control and assurance
- initiate key quality controls and actively contribute to ongoing quality improvement processes in the workplace
- evaluate and implement measures conducive to continual professional development and the optimisation of protocols
- set quality assured and evidence based standards in radiography and radiation therapy plan, measure and analyse outcomes as part of multi professional team
- understand implications for the budget of working practice in relation to radiotherapeutic medical device maintenance protocols

Competences relative to radiation safety

- practise the profession in accordance with current internationally approved statutes and regulations concerning the medical use of ionizing radiation
- optimally reduce and calculate effective radiation doses for patients, staff and carers
- understand and use radiation protection protocols
- advise other professionals regarding safe practice in this area
- set dose reference levels for all examinations and keep them optimised and updated
- critical approach to the use of ionising radiation

These competencies formed the basis of a set of 24 subject specific competencies as compiled by the HENRE Tuning sub group.

The HENRE questionnaire in relation to radiography subject specific competences was distributed at the same time as the generic competences to the same three types of respondents (students, academics and clinicians [representing the employers] asking them to estimate the importance of the competence and the achievement of that competence.

The on line survey asked participants to

- **a.** rate the **<u>importance</u>** of subject specific skills in a medical diagnostic imaging and radiotherapy course at 1st cycle (bachelor) level and
- **b.** rate the **<u>achievement</u>** of these subject specific skills by the extent to which they were/are developed in the education centre in which they presently work (academics) OR they presently attend (students) OR have previously attended (clinicians)

<u>Table 4 Subject specific competencies</u>

1	Work in a multidisciplinary health care team and effectively apply verbal and non-verbal communication with patients and others.
2	Inform and instruct patients appropriately before, during and after procedures.
3.	Document, communicate and report information in a coherent way while complying with data protection regulations.
4.	During the diagnostic or therapeutic procedure, apply ethical principles and obtain consent according to professional standards
5.	Practice according to national and local health and safety protocols
6.	Accept responsibility for one's own actions within the scope of professional practice.
7.	Evaluate the needs of patients in various circumstances and apply appropriate care.
8.	Strategically plan and manage one's own work load and work flow.
9.	Respond to patients clinical needs through appropriate application of diagnostic or therapeutic devices.
10.	Apply knowledge of medical physics, anatomy, physiology and pathology to the production of images
11.	Evaluate the process and result of a diagnostic or therapeutic procedure by relating the images produced to the anatomy, physiology and pathology demonstrated
12.	Demonstrate a knowledge of the different imaging techniques
13.	Recognise the need to adapt practice based on knowledge and experience in different contexts
14.	Demonstrate a holistic knowledge of radiations
15.	Optimise radiation dose management
16.	Acquire new diagnostic and therapeutic technological knowledge and demonstrate the ability to apply it to radiography
17.	Use appropriate diagnostic, therapeutic and ancillary devices effectively and safely
18.	Critically question radiological referrals in terms of analysis of risk and benefit
19.	Apply quality assurance techniques
20.	Apply an evidence base in the development of practice.
21.	Be involved in research and apply new developments within the scope of professional practice
22.	Demonstrate preparedness to undertake continuing professional development.
23.	Inform, instruct and supervise patients, staff and others
24.	Demonstrate an ability to practice in accordance with current legislation governing the use of medical radiation

The rating scale used was from 1-4 for each competence and for a. and b.

For a. Level of importance (1 = least important through to 4= most important)

For b. Development in the education centre (achievement) (1= hardly developed at all; 2= some development; 3= developed; 4= well developed)

The total number of questionnaires completed in relation to subject specific competences was 369 which included 83 academics, 122 clinicians and 164 students from 17 different European countries.

5.2.1 Importance of Subject Specific Competences

The importance of subject specific competences for 1st cycle radiography degree programmes showed mean scores higher than 3.1 for all three groups of participants (viz. students, academics and clinicians [representing employers]) with the majority scoring 3.6 or over. There was remarkable similarity between all respondent types for the highest and lowest mean scores of importance. The following competences showed the highest mean score for importance from all three respondents types; these were related to informing patients, working in a multidisciplinary team and optimising radiation dose management. See table below

Table 5

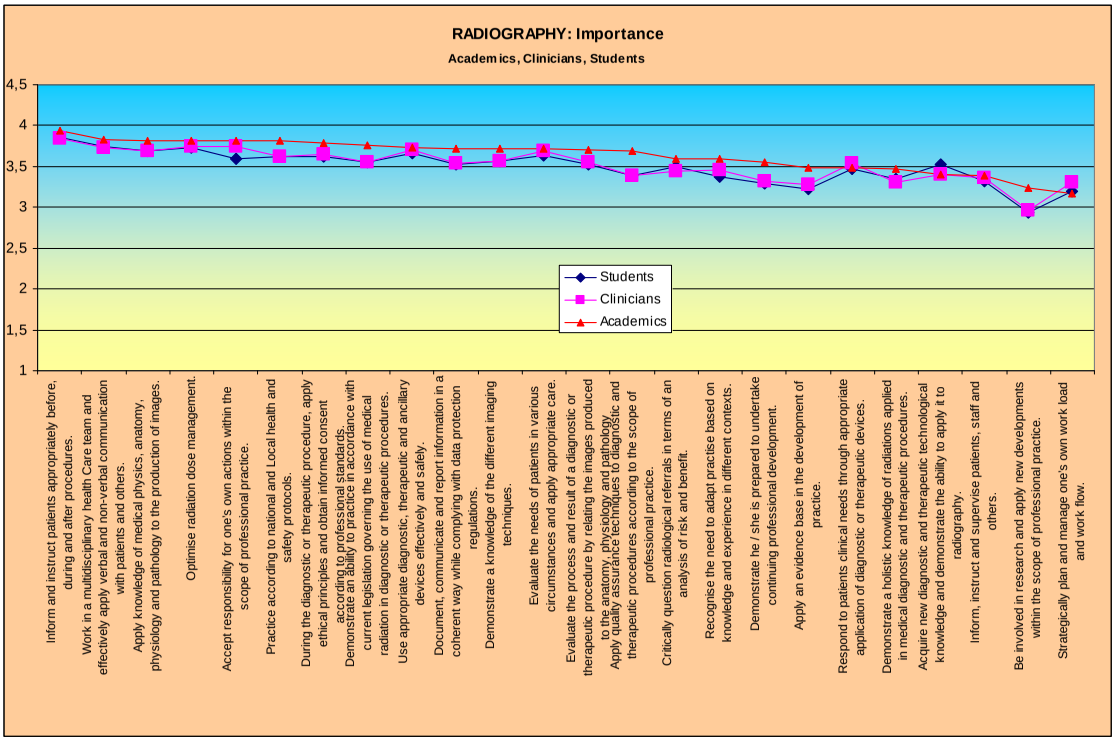
Top ranking of subject specific competences (importance)- showing rank by each group

Subject Specific Competence	Students	Clinicians	Academics
Informing and instructing patients appropriately before, during and after a procedure	1	1	1
Working in a multidisciplinary healthcare team and effectively applying verbal and non-verbal communication with patients and others.	2	4	2
Optimising radiation dose management	3	2	4
Using appropriate diagnostic, therapeutic and ancillary devices	5	5	9
Accepting responsibility for ones own action within the scope of professional practice	9	3	5
Applying knowledge of medical physics, anatomy, physiology and pathology to the production of images	4	7	3

The lowest mean scores although still above 3.1 were to inform, instruct and supervise others, demonstrate a preparedness to undertake continuing professional development, be

involved in research and strategically plan and manage one's own workload and workflow.

Graph 3 *Radiography: 1st Cycle Subject Specific Competences (Importance) Means according to respondent type (Academics, Clinicians, Students)*

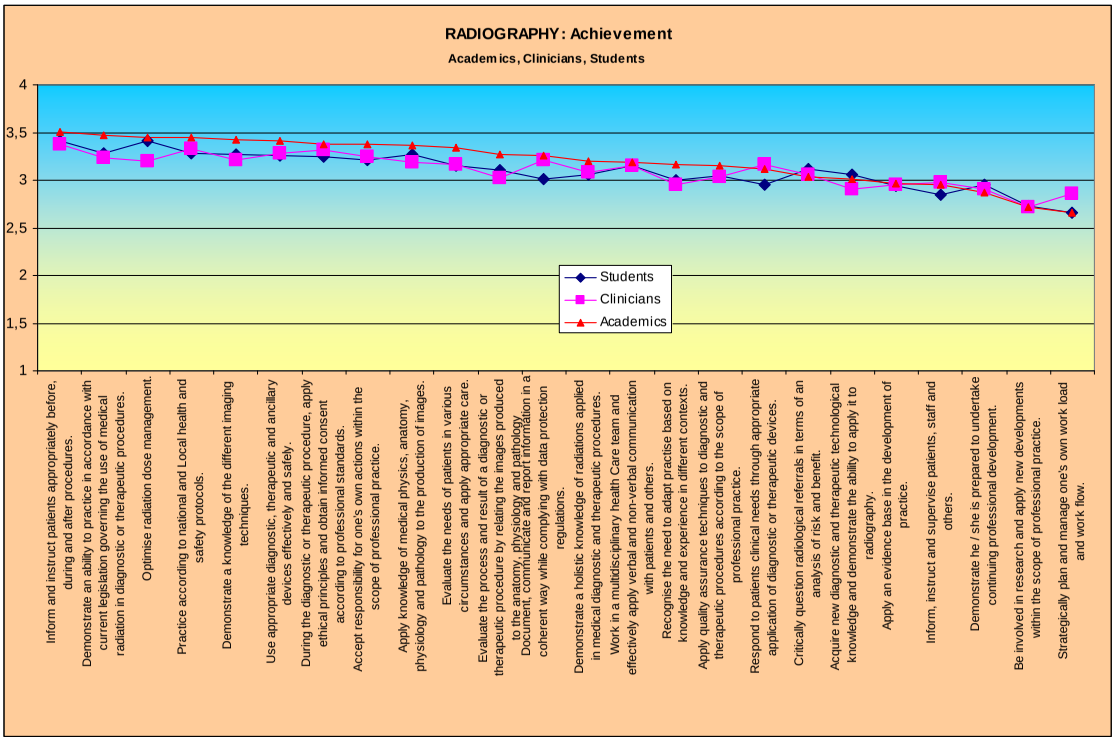


5.2.2 Achievement of Subject Specific Competencies

In the context of the Tuning Template, the achievement of subject specific competences identifies the extent to which these were developed in radiography courses. Mean scores ranged from 2.65 to 3.38 across the 3 types of respondents with the mean highest score for all 3 types of respondents being informing and instructing patients, practising in accordance to national and local health & safety protocols. Academics and students concurred in relation to the optimising of radiation dose and in demonstrating an ability to practice in accordance with current legislation.

As the mean score for these competencies were over 3 demonstrating a strong commitment to achievement, the lowest ranking scores were still very high but did include the application of an evidence base in the development of practice, involvement in research and strategically planning and managing one own's workload. All respondent types had these in the lowest 5. As can be seen by the graph there is very little divergence between respondent types and high scores are evident for all competencies.

Graph 4 *Radiography: 1st Cycle Subject Specific Competences (Achievement) Means according to respondent type (Academics, Clinicians, Students)*



6. Radiography workload and ECTS

6.1 Trends and differences within the European Higher Education area

In the European Higher Education area it is possible to find several models of education in Radiography field. Even after the implementation of Bologna Process one can identify radiography courses with variations from 180 to 240 ECTS. Whilst there do not appear to be significant trends in the way ECTS are allocated, throughout Europe, historical developments in radiography have led to differences in curricula models and consequently have led to a variety of allocation of ECTS.

The following differences are identified as to why some programmes may have more than 180 ECTS:

- Technical and professional model of intervention within the scope of practice in healthcare
    1. The need of obtaining solid competencies concerning the use of ionizing radiation and fully apply the concepts implemented by EURATOM directives;
    2. The existence of a broad diversity of diagnostic and therapeutic methods in the field of diagnostic and therapeutic radiography;
    3. An adequate preparation in the administration of contrast media and radiopharmaceuticals, including the actions involved in life emergency procedures related with adverse reactions;
- The demand of the development on the personal maturity of the recent graduated, concerning the nature of their professional practice
    4. Clinical accountability – the Bachelor in Radiography is ethical, deontological and legally responsible for their professional acts;
    5. Professional identity and autonomy, concerning their role in a multidisciplinary healthcare team.

6.2 Expected workloads expressed in ECTS:

First cycle	240 ECTS in total are recommended (90 ECTS are achieved in clinical practice of which 60 ECTS are achieved in clinical placement)
Second cycle	120 ECTS are recommended for a research-based Masters 60 to 90 ECTS as a minimum requirement for a professionally oriented Masters dependent on the ECTS achieved on the 1st cycle
Third cycle	180 ECTS are recommended

6.3 Recommended ECTS for the radiography first cycle level are as follows:

Scientific areas in the curriculum	**ECTS**	**ECTS %**
Basic sciences	90	38
Broad radiographic sciences	30	12
Clinical radiographic sciences	90	38
Complementary sciences	20	8
Electives	10	4
Total	**240**	**100**

7. Learning, teaching and assessment

Due to implicit human involvement in radiography practice, it is considered important that students have the opportunity to work in small groups for some of their course. However it is recognised that this method of delivery is resource intensive in comparison with other forms of delivery. There has been an increasing use of reflective, critical approaches to learning matched by the use of information and communication technology to support web based and work place learning. Interdisciplinary activity is seen to play an important part in developing the team working skills and practices of radiographers.

Practical skills are often developed through observation of practice, demonstrations, simulations, role play and exposure and engagement in real clinical experiences. Resources are now being allocated to support learners in practice and to prepare students for practice through clinically based x-ray laboratories, clinical skills laboratories and through the use of simulations or virtual practice.

Assessment strategies in radiography at first cycle with pre-registration courses need to address both theoretical and practical based competences. Diverse strategies are used to reflect the assessment of knowledge, skills, attributes and professional values. In the interests of public safety, each programme will identify core components that must be passed in order to achieve the necessary licence/registration to practice.

Learning and teaching in radiography typically involves a combination of the following:

- **Lectures**: These are very time-efficient for students to learn a large part of the material involved in the deep knowledge of radiography. Students may prepare lecture notes. However supporting information can be provided using electronic resources.
- **Practical sessions**: May be organised in tandem with lectures. The aim of practicals is two-fold: understanding the theoretical material through examples and applications to problems.
- **X-ray laboratories or clinical skills laboratories**: The students can practice the safe use of radiation, radiation protection and patient care in a simulated environment. In the first practice phantoms are used but patients are examined when students' skills are developed.

- **Problem based learning:**The presentation of appropriately selected and designed problems develop the ability of students to think critically, creatively and analytically, to find and use learning resources and become team participants which leading to the development of self motivated, independent learners.
- **Reflective practice:** Critical analysis and self awareness is developed through the process of reflection on learning experiences in clinical practice as a way of improving competence and developing professional approaches to healthcare.
- **Case Studies:**The collection and presentation of detailed in depth information about an individual or a group used as a form of qualitative research to develop an holistic understanding of a condition or a situation.
- **Research projects**: These are done individually or in small groups to solve complicated problems relating to the patient, to radiography and to radiation protection. Project, particularly significant final year projects, also affords the opportunity to develop student's understanding of the importance of the research in the field of radiography. The final year project or dissertation is likely to have a practical significance in addition to allowing students to develop their verbal and written communication skills.
- **Observing expert practice**: This will usually allow for a one-to-one interchange between the expert and student and is often used in the practical learning environment. It is, by its nature, a highly intensive and costly method of training. However, the costs reduce significantly when the expert is undertaking their normal clinical practice.

8. Quality enhancement

Quality enhancement may be considered as a deliberate process of change leading to improvement (LTSN generic centre)

HENRE has provided the means for radiography stakeholders across Europe to identify issues which may lead to the quality enhancement of programmes to satisfy the internal and external needs of institutions and individuals in responding to the wider health needs of society. Members have been able to learn from each other with regard to learning and teaching strategies, terminology, peer review, research influencing the curriculum, clinical placement and supervision and the effective use of technological support in

learning and teaching. The learning outcomes approach is an important area of discussion in the HENRE Tuning sub group. Quality enhancement activity is aimed at staff and others to improve student learning and improve the responsiveness of institutions to changes occurring in society.

9. Typical degrees and occupations offered in Radiography

	Typical degrees offered	**Typical occupations**
First cycle	First cycle education at bachelor level is the required qualification to enable radiographers to practise in the fields of diagnostic radiography, nuclear medicine and therapeutic radiography. Typical degrees offered are bachelor in Radiography, Nuclear Medicine and Radiotherapy, or combinations of the above.	• Public and private sector hospitals, clinics • Industry, technical advisor, sales advisor • Education, trainer • Research assistant • System administration • Veterinary
Second cycle	Two different groups of Masters level qualifications are available: in the clinically focused areas and in the non-clinically focused areas. Example of clinically focused qualifications: • medical imaging, therapeutic radiography, nuclear medicine, ultrasound, CT, MRI, dose optimization, health/medical ethics Example of non-clinically focused qualifications: • management, education, radiology information systems, ethics, quality assurance	• Radiographer in specialist fields • Advanced practitioner • Clinical service manager • Technical consultant • Management • Education, lecturer
Third cycle	The research doctorate is related to the creation and expansion of knowledge within the professional field.	• Professor • Associate Professor • Project leader • Research supervisor • Principal researcher • Consultant practitioner

10. The role of Radiography in other degree programmes

Radiography is relevant to other professions and disciplines. Subjects of interest to other professions may include dental radiography, veterinary radiography, art radiography, forensic radiography, hospital design, radiation safety, radiological image interpretation, radiopharmaceuticals, applied anatomy and physiology for imaging, etc.

Possible target groups include nursing, allied health and medical professions, engineers, architects, anthropologists, art restorations specialists, teachers to name a few.

Interdisciplinary education is an important part of all healthcare programmes. The aim of this is to increase mutual understanding and promote multidisciplinary teamwork. Subject areas in interdisciplinary education include health and welfare, legislation, ethics, communication, research methods and others.

Second cycle level descriptors based on the Dublin Descriptors and on the European Qualifications Framework level 7 learning outcomes were developed by the EU funded European Masters Programme in Medical Imaging (EMPIMI) curriculum development project group which has a direct line from HENRE.

11. Second Cycle Generic Competences

Second cycle level descriptor in radiography (generic)
In addition to the level of competence demonstrated by radiographers who have completed the first cycle.

Knowledge and Understanding
A radiographer qualified with a Masters degree is able to:

- identify, formulate, plan, develop and conduct independently or semi-independently research in the appropriate field of medical imaging or radiotherapy
- demonstrate the ability to improve and innovate and to determine the fundamental issues of the profession
- use specialized theoretical and practical knowledge in applying ideas
- demonstrate critical awareness of knowledge issues in the relevant field and at the interface of different fields
- demonstrate the ability to use advanced practice skills in the relevant field

Application of Knowledge and Understanding
A radiographer qualified with a Masters degree is able to:

- apply knowledge and understanding through problem solving abilities in new or unfamiliar environments
- demonstrate a commitment to improving and innovating practice and services
- apply scientific methods in practice and critically appraise strategies that enable practitioners to manage change and promote quality care
- undertake a position with more challenging responsibilities and act as clinical expert or advisor or consultant in the appropriate field

Making Judgments
A radiographer qualified with a Masters degree is able to:

- integrate knowledge, handle complexity and formulate judgements with incomplete or limited information
- reflect on social and ethical responsibilities linked to the application of knowledge and judgements
- appraise the literature to evaluate the relationship between radiography, illness, health and well being

- demonstrate the fundamental issues of radiography from a broad and deep perspective

Communication

A radiographer qualified with a Masters degree is able to:

- communicate at an advanced level to specialist and non specialist audiences
- demonstrate an ethical approach to all service users at an advanced level
- operate effectively and confidently across national and international borders and within different cultures
- participate in debates related to radiography within a wide health and social context

Learning Skills

A radiographer qualified with a Masters degree is able to:

- demonstrate the learning skills of an autonomous/ self directed learner
- use radiography theories and research methodologies and methods in an independent, autonomous manner
- demonstrate the ability to operate and adapt in challenging and rapidly changing environments
-

12. Third cycle level descriptors in radiography

Radiography graduates who have completed both the first and second cycles are eligible to proceed to the third cycle in most European countries. There are some exceptions to this across Europe. These descriptors have yet to be developed by the HENRE network together with the EMPIMI group as yet. The areas for radiographers to pursue third cycle awards may be A. radiography professional awards; B. research awards; C. taught awards from any number of Higher Education Institutions (HEIs) across Europe and beyond.

Bibliography

The documents that are references for the subject area of Radiography are:

- The Quality Assurance Agency for Higher Education (2001) *Benchmark statement: Health care programmes – Radiography*.
- International Society of Radiographers and Radiological Technologists (1991) *Professional Standards for the Education of Radiographers*. London: ISRRT.
- International Society of Radiographers and Radiological Technologists (2004) *Guidelines for the Education Of Entry-level Professional Practice In Medical Radiation Sciences*. ISRRT, available at http://www.isrrt.org/, 18/04/2007
- Joint Quality Initiative (2004) Shared Dublin descriptors for the Bachelors, Masters and Doctoral awards, available at http://www.jointquality.org/,

Gonzalez & Wagenaar 2007 p.139

APPENDIX ONE

A Bachelor in Radiological Sciences is able to:
Adapted from: The Quality Assurance Agency for Higher Education (2001) *Benchmark statement: Health care programmes – Radiography*.

Instrumental competencies
Skills for analysis and synthesis, organization, basic general culture, communication.

Identification and assessment of health and social care needs
The award holder should have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education and is informed by knowledge at the forefront of their field of study. The practitioner will be able to:

- Gather relevant information from a wide range of sources including electronic data;
- Adopt systematic approaches to analysing and evaluating the information collected;
- Communicate effectively with the client/patient, (and his/her relatives/carers), group/community/population, about their health and social care needs;
- Use a range of assessment techniques appropriate to the situation and make provisional identification of relevant determinants of health and physical, psychological, social and cultural needs/problems;
- Recognise the place and contribution of his/her assessment within the total health care profile/package through effective communication with other members of the health and social care team.

Formulation of plans and strategies for meeting health and social care needs
The award holder should be able to:

- Work with the client/patient, (and his/her relatives/carers), group/community/population, to consider the range of activities that are appropriate/feasible/acceptable, including the possibility of referral to other members of the health and social care team and agencies;
- Plan care within the context of holistic health management and the contributions of others;
- Use reasoning and problem solving skills to make judgements/decisions in prioritising actions;
- Formulate specific management plans for meeting needs/problems, setting these within a timescale and taking account of finite resources;
- Record professional judgements and decisions taken;
- Synthesise theory and practice;
- Conduct appropriate activities skilfully and in accordance with best/evidence-based practice;
- Contribute to the promotion of social inclusion;
- Monitor and review the ongoing effectiveness of the planned activity;
- Involve client/patient/members of group/community/population appropriately in ongoing effectiveness of plan;
- Maintain records appropriately;
- Educate others to enable them to influence the health behaviour of individuals and groups;
- Motivate individuals or groups in order to improve awareness, learning and behaviour that contribute to healthy living;
- Recognise opportunities to influence health and social policy and practices.

Evaluation

The award holder should be able to:

- Measure and evaluate critically the outcomes of professional activities;
- Reflect on and review practice;
- Participate in audit and other quality assurance procedures;
- Contribute to risk management activities.

Interpersonal competencies

Skills for teamwork criticize and self-criticise, integrate multidisciplinary teams, understanding diversity and multi-cultural issues.

Professional autonomy and accountability of the radiographer
The award holder should be able to:

- Maintain the standards and requirements of professional and statutory regulatory bodies;
- Adhere to relevant codes of conduct;
- Understand the legal and ethical responsibilities of professional practice;
- Maintain the principles and practice of patient/client confidentiality;
- Practise in accordance with current legislation applicable to health care professionals;
- Exercise a professional duty of care to patients/clients/carers;
- Recognise the obligation to maintain fitness for practice and the need for continuing professional development;
- Contribute to the development and dissemination of evidence-based practice within professional contexts;
- Uphold the principles and practice of clinical governance.

Professional relationships of the radiographer
The award holder should be able to:

- Participate effectively in inter-professional and multi-agency approaches to health and social care where appropriate;
- Recognise professional scope of practice and make referrals where appropriate;
- Work, where appropriate, with other health and social care professionals and support staff and patients/clients/carers to maximise health outcomes;
- Maintain relationships with patients/clients/carers that are culturally sensitive and respect their rights and special needs.

Personal and professional skills of the radiographer
The award holder should be able to:

- Demonstrate the ability to deliver quality patient/client-centred care;
- Practise in an anti-discriminatory, anti-oppressive manner;
- Draw upon appropriate knowledge and skills in order to make professional judgements, recognising the limits of his/her practice;
- Communicate effectively with patients/clients/carers and other relevant parties when providing care;
- Assist other health care professionals, support staff and patients/clients/carers in maximising health outcomes;

- Prioritise workload and manage time effectively;
- Engage in self-directed learning that promotes professional development;
- Practise with an appropriate degree of self-protection;
- Contribute to the well-being and safety of all people in the work place.

Profession and employer context
The award holder should be able to:
- Show an understanding of his/her role within health and social care services;
- Demonstrate an understanding of government policies for the provision of health and social care;
- Take responsibility for his/her own professional development;
- Recognise the value of research and other scholarly activity in relation to the development of the profession and of patient/client care.

Systemic competencies

Skills to apply theoretical knowledge in practice, to learn, adapt to new situations, generate new ideas, leadership, and autonomy.

Knowledge and understanding
The award holder should be able to:
- Understanding of the key concepts of the disciplines that underpin the education and training of all health care professionals, and detailed knowledge of some of these. The latter would include a broad understanding of:

    - The structure and function of the human body, together with a knowledge of dysfunction and pathology;
    - Health and social care philosophy and policy, and its translation into ethical and evidenced based practice;
    - The relevance of the social and psychological sciences to health and healthcare;
    - The role of health care practitioners in the promotion of health and health education;
    - The legislation and professional and statutory codes of conduct that affect health and social care practice.

Skills
Capacity for reflection
The award holder should be able to:

- Critically appraise the science and practice of diagnostic radiography;
- Reflect on the potential and limitations of professional knowledge;
- Evaluate the impact of professional knowledge on practice.

Gathering and evaluating information and evidence
The award holder should be able to:
- Synthesis of knowledge and understanding of the scientific basis of diagnostic imaging and application to practice;

- Accurate analysis and processing of information and data in order to conduct examinations efficiently
- and effectively;
- Clinical reasoning based on judgements made from the verbal and physical presentation of an individual and information from a variety of sources including the referring practitioner; evaluation, in an appropriate and timely fashion, of the specific clinical situation encountered; and evaluative judgements of technical and clinical outcomes;
- Professional judgement skills in order to make informed, sensitive and ethically sound professional judgements and also to evaluate and interpret diagnostic images produced;
- Reflection on, and during, practice;
- The ability to think logically, systematically, and conceptually.

Problem solving
The award holder should be able to:

- Seek appropriate solutions to problems encountered in clinical practice in the light of relevant guidelines and evidence, the nature and presentation of the patient, and the location in which the examination is conducted;
- Analyse and process information and data accurately in order to conduct examinations efficiently and effectively;
- Sequence and adapt the radiographic process in the light of patient care needs, required clinical and radiographic outcomes, and available resources.

Practice
The award holder should be able to:

- Assess the patient's needs through interrogation of the clinical history in order to determine the precise nature of the examination to be conducted;
- Justify and match radiographic examination or imaging modality to clinical need, based on evaluation of evidence from professional or patient based sources;
- Prepare the patient, both physically and psychologically, in order to carry out an effective clinical examination;
- Position patients and clients accurately, safely and sensitively for examinations;
- Manipulate the range of technological equipment safely and efficiently;
- Generate and manipulate images (including verification of exposure factors) effectively and appropriately in relation to the pathology or trauma to be demonstrated;
- Evaluate and interpret images produced, making judgements about the acceptability of the quality of the images in the context of the patient's condition. This includes making judgements about the need to undertake further imaging procedures or additional projections/procedures and the need to make judgements about the absence or presence and possible nature of trauma or pathology demonstrated;
- Record and report findings appropriately;
- Apply effective moving and handling skills in order to protect patients and self from injury or further injury or, in the case of patients, further aggravation of an existing condition which could be concomitant with the reason for presentation. On occasion this will involve the movement of patients with severe trauma, acute pain and/or clinical shock and pre-existing physical deformity;
- Initiate resuscitation when necessary;
- Introduce contrast agents into the body when appropriate, including intravenous administration;
- Manage time effectively, including prioritisation of work load whilst delivering high quality care.

Communication and interpersonal
The award holder should be able to:

- Appropriate and effective inter- and intra-professional communication in written, oral and presentation formats;
- Effective supervision of students and other staff;
- Use of a wide range of information sources, for example, manufacturers' technical information and government policies and papers, in order to provide qualitative reports about the nature of the service, and trends and changes in the service;
- The integration of research and procedural data in order to produce reports contributing to effective patient management;
- The ability to collect and interrogate data relative to the performance of both the individual practitioner and the local service to monitor and influence practice.

Numeracy
The award holder should be able to:

- Confidence and competence in manipulating exposure parameters and variables in order to optimise dose and image quality considerations, according to the unique needs/interests of each patient and the examination being undertaken;
- Numerical competence in determining doses required for contrast agents, analgesic and emergency drugs;
- Sufficient familiarity with, and competence in, manipulation of likely radiation doses and variables in order to advise/inform patients and referring clinicians of the relative risks arising from individual procedures;
- The ability to collect, interrogate, interpret and present relevant data from a range of sources and by a variety of methods;
- Arithmetical and statistical competence in order to interrogate data generated through audit and research.

Medical devices
The award holder should be able to:

- Confidence and competence in using the medical devices required for moving and handling patients, integrated into the diagnostic imaging and therapeutic process;
- Effective use of information communication technology in relation to information about or from patients, service management, teaching and learning, continuing professional development and research;
- Confidence and competence in utilising the extensive range of image generation, manipulation, display and recording devices used in radiographic and therapeutic practice.

Appendix TWO *1st cycle level ECTS (240 ECTS)*

1Adapted from: International Society of Radiographers and Radiological Technologists (2004) *Guidelines for the Education Of Entry-level Professional Practice In Medical Radiation Sciences*. ISRRT

Scientific areas	**ECTS**
Basic sciences	**90 ECTS (38%)**

Biomedical Sciences :

Gives students an understanding of the structure, function and disease patterns of the human body. The courses should include anatomy, physiology, pathology and biochemistry.

Physical Sciences:

Provides students with the biomedical physics competences underpinning the scientific, effective, safe and efficient use of medical devices used in medical imaging and/or radiation therapy.

Radiobiology:

Gives students an understanding of cell biology in humans and the effects of ionizing and non-ionizing radiation on the human body.

Statistics/mathematics:

Mathematics forms the basis for an appreciation of scientific principles. A basic understanding of statistics and statistical analysis enables the student to understand and analyze data produced.

Management :

Provides the student with an understanding of management and organizational theory, and an opportunity to develop his knowledge and skills in the management process.

Research:

Provides the student with the opportunity to understand and use the elements involved in the research process.

Healthcare sciences/Patient care/ethics:

Provides students with an understanding of the concepts of patient care including the patient's physical, social, cultural and psychological needs.
In addition, the students will learn the principles of hospital acquired infection and their prevention.
Students will also gain knowledge and understanding as well as experience of basic life support and

emergency procedures.
Students will gain a practical approach to ethical decision making with regard to health services users, colleagues and the wider population.

Broad radiography scientific area sciences	**30 ECTS (12%)**

Radiation safety and protection

Provides the student with knowledge and understanding of radiation hazards and effects, dose optimization and radiation protection requirements for the staff, patient and the general public.
In addition, students will gain knowledge of the relevant national and international directives and legislation, thus enabling effective application of appropriate protection.

Quality assurance

Provides the student with the understanding and skills necessary to evaluate the procedures and imaging/treatment systems thus ensuring the provision of effective, safe and efficient service to the patient, clinician, employer, and other members of the health care team.

Medical devices

This course provides an understanding of the operation and maintenance of all medical devices for professional purposes, thus enabling the student to competently use the devices.

Specific radiography scientific area sciences	**90 ECTS (38%)**

Clinical education

Clinical education offered by a programme must be well integrated into and supported by the academic courses offered. The goal of every programme should be to bring each student to a point where they can deliver, in a consistent manner, patient care services within areas of demonstrated competence
It is recognized that learning in practice-based settings is of equal value to that in the didactic setting. In the clinical setting, a student must, at all times, be supervised by registered/accredited professionals and must be considered supernumerary to department personnel.

Radiological protocols

This course provides the student with the concepts and skills required to perform required procedures under a

variety of conditions. Attention must be paid to the integration of the theoretical concepts and laboratory techniques with clinical applications.	
Broad Scientific sciences	**20 ECTS (8%)**
Behavioural and Psychological sciences : Provides knowledge and understanding of human development and behaviour from the birth to old age.	
Communication: These skills will enable the student to interact/function effectively in various situations.	
Information technology Provides the student with knowledge and understanding of computer and information technology and its application to radiography and the wider field	
Electives	**10 ECTS (4%)**
Provides the student with an opportunity to pursue a particular interest at the institution or abroad. Such electives may not necessarily be related to radiographic medical devices, e.g. computer languages, economics, philosophy, health and fitness courses, activities in the national society/students' union but must be weighted such that they form a very minor course requirement. (This list is by no means exhaustive and can be modified to suit the local conditions)	

Appendix THREE

Based on the Dublin Descriptors[1] the Higher Education Network for radiographers in Europe (HENRE) Descriptors are as follows:

Original Shared 'Dublin' descriptors for First Cycle	**HENRE Descriptors for 1st cycle awards in Radiography**
Qualifications that signify completion of the first cycle are awarded to students who:	Qualifications that signify completion of the first cycle in Radiography are awarded to students who:
1. Have demonstrated knowledge and understanding in a field of study that builds upon and their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;	1. Have demonstrated skills, knowledge and understanding in the field of healthcare that build upon training undertaken within or concurrently with general secondary education, are typically at a level of advanced study and, in the principal study area of radiological sciences, are informed by the experience and knowledge of those at the forefront of their field;
2. Can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;	2. Can apply their skills, knowledge and understanding in the field of radiological sciences in a manner that indicates a professional approach to their work, and have demonstrated competences as well as through devising and sustaining arguments and solving problems within their field of study;
3. Have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues;	3. Have the ability to gather and interpret relevant data (usually within the field of healthcare and radiological sciences) to inform judgements within their professional activity that include reflection on practice and, where relevant, social, scientific or ethical issues;
4. Can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;	4. Can communicate to others the understanding, ideas, information, problems and solutions to both specialist and non-specialist audiences;
5. Have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.	5. Have developed those learning and practical skills that are necessary for them to continue to undertake further study with a high degree of autonomy.

1. Available at www.jointquality.org

1Joint Quality Initiative (2004) Shared 'Dublin' descriptors for Short Cycle, First Cycle, Second Cycle and Third Cycle Awards. Available at www.jointquality.org